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1 IN THE UNITED STATES DISTRICT COURT
 2 FOR THE SOUTHERN DISTRICT OF OHIO
 3 EASTERN DIVISION AT COLUMBUS

4 CITIZENS AGAINST POLLUTION,
 5 Plaintiff,
 vs. Civil No.: 2:04-CV-00371
 Judge Gregory Frost
 Mag. Judge Mark Abel
 6 OHIO POWER COMPANY,
 Defendant.

7 _____/ 8
 9 D E P O S I T I O N O F
 10

11 WITNESS: STUART BATTERMAN, Ph.D. (Volume II)
 12 LOCATION: Offices of Patricia Murray & Assoc.
 13 122 South Main Street
 Ann Arbor, Michigan
 14 DATE: January 6, 2006

15 APPEARANCES:
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20 Reporter: Karen Klerekoper, CSR-4250, RPR

1 Ann Arbor, Michigan

2 January 6, 2006

3 At 9:05 a.m.

4
 5 STUART BATTERMAN
 6 HAVING BEEN CALLED BY THE DEFENDANT AND SWORN:
 7 EXAMINATION (Con't)

8 BY MS. CRABTREE:

9 Q. Good morning, Dr. Batterman.

10 A. Good morning.

11 Q. When we left yesterday, I believe we were on 2.3.6 on
 12 page 16 of your report. Go ahead and flip to that.
 13 This is a section entitled Goals of Ohio
 14 EPA Toxic Air Emission Policy Are Not Satisfied.

15 In here, you're talking about the MAGLCs,
 16 or MAGLCs, in Ohio; is that correct?

17 A. Yes.

18 Q. Are you aware of whether Ohio EPA has taken any
 19 measures to make the Gavin facility reduce its H₂SO₄
 20 or SO₃ to the MAGLC levels?

21 A. I haven't seen any evidence to that effect.

22 Q. Are you aware of whether the MAGLCs are mandatory
 23 limits?

24 A. I understand that there is some debate whether or not
 25 they are a policy or a guideline.

1 I N D E X

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12 (Exhibits not marked)

1 Q. What would you consider the MAGLCs?

2 A. Based on the fact that it's called the Air -- it's
 3 called a policy, I would take it for what it is. But,
 4 in essence, it's, you know, an attempt to regulate a
 5 pollutant to provide a protective level for the
 6 population. And, of course, all state agencies have a
 7 degree of flexibility in how they interpret their
 8 policies and guidelines and, for that matter, how they
 9 interpret standards.

10 Q. Do you know how often Ohio EPA reviews this policy?

11 A. I haven't reviewed that information.

12 Q. Turning to 2.3.7, on this same page, which is entitled
 13 Emissions of SO₃/H₂SO₄ Are Ongoing and the 2002
 14 Monitoring Data Remains Pertinent.

15 Again, where are those 2004 levels coming
 16 from that you cite here, this 10 to 15 parts per
 17 million, at both Gavin units?

18 A. I believe that these are values expressed as targets,
 19 more or less, for the Gavin units that were in
 20 materials that were prepared by Ohio Power. They were
 21 present in PowerPoints that we would talked about.
 22 They were present in depositions of Osborn that we
 23 also talked about yesterday.

24 Q. So these aren't coming from that Excel spreadsheet
 25 that we were talking about yesterday?

1 A. No, I don't believe they were.
 2 Q. I think you answered this yesterday: Did you look at
 3 any actual stack test data from 2004?
 4 A. I have not seen actual stack test data for 2004.
 5 Q. Do you think that the 2002 ambient monitoring data
 6 that's summarized in your Table 1 are indicative of
 7 current levels of ambient concentrations in the
 8 Cheshire area?
 9 A. I have to speculate on that because I have seen no
 10 ambient monitoring data for 2004 and, to my knowledge,
 11 none has been taken after 2002. So my speculation is
 12 based on things otherwise as they were in 2002. In
 13 that case, they would be representative.
 14 Q. Have you seen any data that would indicate to you
 15 things have changed since then?
 16 A. Since when?
 17 Q. Since 2002.
 18 A. Are we referring to 2006, 2004, 2005?
 19 Q. Anything since 2002 that would indicate to you that
 20 the 2002 data may not be relevant?
 21 A. Sure. For example, in 2002, only one of the SCRs was
 22 operating, and in subsequent years, both of them were
 23 operating. I think in 2003, only one of them was
 24 operating, but 2004 to the present, I believe both are
 25 operating.

1 Q. Okay. Do you know approximately how far the stacks
 2 are from the actual road?
 3 A. I don't have a distance for you in meters, but it's a
 4 short distance. I have examined aerial views and I
 5 just don't have a recollection of how many meters or
 6 feet it is.
 7 Q. Fair enough. In your 2.4.1, entitled Individuals Live
 8 in High-Exposure Areas, you reference from Table 6 in
 9 your report. If we could turn to that, please. It's
 10 on page 26.
 11 Why did you choose just these 17 individual
 12 residences?
 13 A. These were the CAP members whose names and addresses I
 14 was given. These were the extent to my knowledge of
 15 the CAP members who had provided that information.
 16 Q. Do you know if this is all the CAP members or just a
 17 subset that you were given?
 18 A. I do not know that for sure.
 19 Q. Okay. Under distance, that's kilometers from the
 20 Gavin stacks or the Gavin property?
 21 A. I think what I did here was to calculate the distance
 22 between the midpoint of the Gavin stacks.
 23 Q. Between the two stacks side by side?
 24 A. I calculated what we would call the midpoint, or the
 25 centroid, the point right in between the two, and I

1 Operation, as well known, SCRs will
 2 increase the quantities, the emission rates, of
 3 sulfuric acid precursors, SO₃. So if the emission
 4 rates went up, then ground-level concentrations have a
 5 good likelihood of going up, since, as I indicated to
 6 you the other day, concentrations can be proportional
 7 to emissions.
 8 Q. Moving on to page 17, which begins section 2.4 of your
 9 report, discussing exposure in the Cheshire community.
 10 The first question for you is, you say that
 11 the plant is just a few yards from the road, do you
 12 actually know how far that is?
 13 A. Well --
 14 Q. Do you see where I am?
 15 A. No, I don't.
 16 Q. I'm sorry. It's right above 2.4.2, the paragraph that
 17 starts, "Beyond exposures." It's the last sentence in
 18 that paragraph.
 19 A. Yeah. Well, I have driven down that road and,
 20 essentially, the road abuts the facility and, I
 21 believe, in fact, the Gavin plant has unloading
 22 facilities from the river on the opposite side of the
 23 road. So, essentially, the road doesn't drive through
 24 the property. I don't believe they own the roadway,
 25 but it's abutting.

1 believe I calculated distances from that --
 2 Q. Okay.
 3 A. -- that location. I think I've probably described
 4 that somewhere.
 5 No, I just said from the Gavin facility
 6 stacks. Since the stacks are relatively close
 7 together, it's probably within the margin of error.
 8 Q. There are two residences in your Table 6 that are less
 9 than 2 kilometers from that midpoint measurement; is
 10 that correct?
 11 A. That's what I found.
 12 Q. Did you use these distances to calculate an exposure
 13 risk to these residences based on the distance from
 14 the stacks?
 15 A. Not directly.
 16 Q. In the second nonitalicized paragraph in 2.4.1 --
 17 A. Which page, please?
 18 Q. I'm back on 17. It starts out, "The CAP members'
 19 residences." You have -- according to your Screen 3
 20 dispersion model, the maximum ambient concentration
 21 occurred at downwind distance of about 1.24 kilometers
 22 downwind.
 23 There are no residences listed in your
 24 Table 6 that are close to that plant, correct?
 25 A. The closest residence is approximately 1.4 from the

1 midpoint, given the plus or minus that I indicated
 2 before, were in that same realm of distance.

3 It's also, I think, understood with
 4 my -- with follow-up to the sentence that you have
 5 identified that, in fact, distances are -- I'm sorry,
 6 concentrations change only slightly as you move to
 7 slightly longer or slightly shorter distances.

8 Q. You have here the ambient concentration at 1.4
 9 kilometers, which would be the closest residence in
 10 your Table 6, is only about 5 percent lower at this
 11 distance?

12 A. That's correct.

13 Q. What about the residences -- there are 2 residences,
 14 here at the top of your Table 6, which are 6.6
 15 kilometers away. What would you expect the ambient
 16 concentration to be at that distance?

17 A. I think your question is asking me, if you could
 18 clarify, what is the concentration that I would expect
 19 Screen 3 would provide?

20 Q. Yes.

21 A. I don't know. I don't memorize the numbers that come
 22 out of a model like that.

23 Q. You say they go down by 5 percent when you go to 1.4
 24 kilometers. Did you see by how much those predicted
 25 levels went down as you got further and further away

1 time outdoors.

2 Did you make any attempt to correlate the
 3 timing of plume touchdowns with when those children
 4 might be on their way to school or outdoors?

5 A. In general, the data don't permit that determination.
 6 The monitoring, as we talked yesterday, was sporadic,
 7 daylight hours. It's in the first, say, phase from
 8 2001 to over the 2001 period. Averaging times were
 9 basically daylight hours, six to eight hours,
 10 typically.

11 You could not determine from a plume
 12 detection during the 2001 monitoring whether that
 13 would have occurred at a noon recess, whether it would
 14 have occurred when the students were inside. That
 15 information was not available from the 2001 data.

16 From the 2002 data, the sampling times were
 17 not always specified and, thus, I wasn't able to make
 18 that determination either.

19 In any event, as I talked about, my opinion
 20 regarding the adequacy of the monitoring is that that
 21 would not be a reliable determination.

22 Q. Okay. You talk about the children being outdoors. Is
 23 it generally true that if you were indoors, you have
 24 less of an exposure to ambient concentrations of
 25 H₂SO₄?

1 from the plant?

2 A. Yes. Screen 3, in conventional application, using
 3 what is called an automatic distance array, in other
 4 words, it calculates concentrations at a variety of
 5 distances from -- I think I ran it from 100 meters to
 6 10 kilometers -- will essentially calculate the
 7 concentrations at roughly 50 distances in between
 8 those two end points.

9 And I looked at what the concentration was
 10 at intermediate distances, for example, residences for
 11 Rose Gilles at 6.6, but I just don't recall. It's in
 12 the printout of the model. And the point here, in a
 13 typical application of Screen 3, is to look at worst
 14 case. I didn't look at -- focus my attention on
 15 distances beyond the worst case.

16 Q. But those distances would be in the Screen 3 results
 17 in your work papers?

18 A. In the model output, yes.

19 Q. Okay. Back on 17, the next paragraph down, you have:
 20 Also of concern are detections of the H₂SO₄ plume at
 21 locations of sensitive or vulnerable populations. And
 22 you talk about the River Valley School and the
 23 potential for exposure for children on their way to
 24 school, children who are exercising and children
 25 engaged in sports where they may spend considerable

1 A. That would be my expectation. I would say that there
 2 has been very little monitoring indoors of H₂SO₄, and
 3 the expectation is, yes, that there would be
 4 attenuation indoors, especially if windows were closed
 5 and air conditioners were on, so forth.

6 If the windows were open and there is a
 7 breeze present, and so forth, the attenuation would be
 8 reduced and exposures indoors would be higher.

9 Q. The last paragraph in this section starts, "Beyond
 10 exposures at home or in schools, CAP members and other
 11 community members may" --

12 A. I'm sorry, which section are you?

13 Q. The last paragraph in 2.4.1.

14 -- "may have exposure to H₂SO₄ plume at
 15 other locations where they may work, drive through or
 16 recreate."

17 A. Yes.

18 Q. When you are driving along Route 7 near the Gavin
 19 plant, the Kyger Creek and Gavin plants are quite
 20 close together, correct?

21 A. They are within a few miles, yes.

22 Q. The CAP members are actually describing symptoms and
 23 smells while driving along Route 7; is that your
 24 recollection?

25 A. A number of the reports from community members were

1 while driving, that's correct.

2 Q. Let's go ahead and look at Table 7, which details some
3 of these complaints. It's on page 27 of your report.

4 Now, first one of the individuals you have
5 listed here is Stinson. Do you know if that's Paul or
6 April Stinson?

7 A. No, I can't say for certain because many of these are
8 e-mails, and I don't recall whether it was signed Paul
9 or April.

10 Q. You don't have any specific documents cited for this
11 table summary. Do you know where you got all of
12 these?

13 A. Yeah, I think most of these were in interrogatories
14 that you have. They were also in e-mail evidence as
15 well. That was provided electronically.

16 Q. Did you ever look at the handwritten diaries of the
17 CAP members?

18 A. I have seen some handwritten materials, but I don't
19 know that I would consider them diaries.

20 Q. What do they look like?

21 A. To my recollection, they look like they were on a pad,
22 but I don't recall the details beyond that.

23 Q. Okay. So this -- these are complaints from two,
24 perhaps three, different people then?

25 A. Well, I'm not sure how many because Stinson could

1 taken in isolation, it seems pretty unlikely that you
2 would have burning in nose and lungs or an odor as you
3 drive past a facility that would likely be caused by
4 something other than the sulfuric acid plume.

5 Taken in isolation, clearly you can get
6 burning in your eyes if you've just eaten some spicy
7 food or put your fingers in your eyes after touching
8 an irritant, or something like this. So these are
9 general irritant symptoms, and a number of factors can
10 cause irritation.

11 Q. But you are saying in driving past a facility such as
12 Gavin, you can't think of any other cause for these
13 symptoms, other than the sulfuric acid mist?

14 A. No. I said it appeared to me to be unlikely, in my
15 opinion, that other factors would cause this kind of
16 response.

17 Q. I noticed in your resume, you have done some work with
18 particular emissions from motor vehicles. If one of
19 these individuals was driving by the plant in an
20 open-top Jeep, is there anything in the vehicle
21 emissions that might cause these symptoms?

22 A. An individual is driving in a open-top Jeep?

23 Q. Uh-huh.

24 A. In a properly operating vehicle, the emissions from
25 that vehicle are discharged through the tail pipe at

1 represent one or the others. Mulford is another
2 individual. I'm not sure if it's a wife, husband,
3 child, whatever. Several members, in any event.

4 Q. Probably five, or less?

5 A. My guess is that's correct.

6 Q. Okay. They detail some symptoms here. One of the
7 first ones I see is a sulfur odor or sulfur taste.

8 Would you associate a sulfur odor or sulfur
9 taste with sulfuric acid mist?

10 A. Well, I'm not probably able to judge how someone else
11 characterizes an odor or a taste.

12 We know that olfactory response is very
13 subjective, and people have different descriptors.
14 These individuals have not been trained to
15 characterize odors, and the way they characterize it
16 is, as I indicated, subjective. So I would not rule
17 out a sulfur odor and burning in a nose, and so forth,
18 as an inappropriate descriptor for an untrained
19 individual.

20 Q. Looking at these types of symptoms, is there anything
21 else that could cause these kinds of symptoms?

22 A. Taken in isolation, there are other factors that could
23 cause these symptoms.

24 Q. What would those factors be?

25 A. Nothing specifically comes to mind because I think,

1 the rear of the vehicle, and occupants shouldn't be
2 exposed to very much of that. So I would suspect that
3 the open-top Jeep would not produce a pollutant that
4 the vehicle operator was having a particular problem
5 with. Most people, when they have exhaust leaks, and
6 so forth, would get that repaired. Certainly you can
7 have exhaust leaks that make their way into the
8 passenger cabin.

9 Q. If you are in an open-top Jeep closely following
10 another vehicle, would you expect any of these
11 symptoms as a result of the emissions from the vehicle
12 in front of you?

13 A. Vehicles in front of you have been noted to produce
14 concentrations within trailing vehicles. Whether or
15 not it's open is probably not that significant of an
16 issue.

17 Q. Would those emissions from the vehicle in front of you
18 potentially cause any of these symptoms?

19 A. I think it's unlikely in most cases that
20 properly operating vehicles would cause burning in
21 nose and throat, lungs, and severe irritation symptoms
22 for most individuals.

23 Q. Did you ask to see any medical record for the
24 complainants of these symptoms?

25 A. I asked whether there were medical records available.

1 Q. What was the response?
 2 A. I don't believe that medical records were available.
 3 Q. Did you talk to any of them?
 4 A. Talk to any of them, being who?
 5 Q. Any of the people making these symptom complaints.
 6 A. I met Mr. Stinson and chatted with him.
 7 Q. Did you talk to him about his health complaints?
 8 A. I think our conversation included his health
 9 complaints.
 10 Q. What were Mr. Stinson's health complaints?
 11 A. In the context of discussion, was very similar to
 12 what's been described in the report here. He
 13 described his -- the perceptions that he had when he
 14 believed he was exposed to -- when he would determine
 15 what he would call the blue plume.
 16 Q. If there were medical records for these people
 17 complaining of these symptoms, would you consider them
 18 relevant to your analysis?
 19 A. It would be helpful.
 20 Q. Do you find it unusual that your Table 7 only includes
 21 a small number of people, we're both guessing five or
 22 less, based on the two last names?
 23 A. Do I find it unusual? No, not really.
 24 Q. Why?
 25 A. Well, a couple of the reasons, I guess. First of all,

1 the earlier record is fairly similar, but I don't
 2 recall in detail what that looks like.
 3 Q. Okay. Do you know whether any of these people in your
 4 Table 7 have asthma?
 5 A. I'm not certain. I forget. I know that there are
 6 individuals in the community that have asthma.
 7 Q. But you are not sure if it's any of these individuals?
 8 A. I'm not sure if it's any of these.
 9 Q. What about allergies?
 10 A. I am not sure about that either.
 11 Q. So is it fair to say, you are not familiar with the
 12 personal medical histories of the people listed in
 13 Table 7?
 14 A. That's a fair characterization.
 15 Q. Okay. How do you differentiate between symptoms
 16 caused by the Gavin SO3/H2SO4 emissions versus other
 17 ambient sources of SO3 or H2SO4?
 18 A. In general, I think I would look for the
 19 correspondence between factors that would indicate
 20 that the Gavin facility is producing the exposures.
 21 And the concordance or simultaneity or near
 22 simultaneity from health responses from individuals in
 23 that community. Is that too technical?
 24 Q. I'm looking at it now.
 25 A. I would also look for the likelihood of exposures from

1 my understanding is that this is a company town and
 2 employees who are working for the firm, or who have
 3 connections for the firm, are quite hesitant to speak
 4 up. The town is relatively small. We have a
 5 population size, and in a population, you only have so
 6 many people who are willing to participate.

7 Sensitivities of individuals vary and, for
 8 example, in a town you might have so many children and
 9 only a percentage of those children, for example,
 10 would have asthma. And of those asthmatics, perhaps
 11 only a percentage of those would respond to plumes.

12 So there are a number of factors that tend
 13 to reduce the number of people who respond. I suspect
 14 a lot of individuals who had problems dealing with
 15 conditions -- and this is all speculation for me --
 16 have left the town, were bought out. So it's not too
 17 surprising that the sample size in my table is small.

18 Q. I notice that the earliest complaint in your table is
 19 April of 2003. Do you know why you didn't have any
 20 earlier complaints?

21 A. I didn't actually attempt to provide a complete
 22 chronological record of complaints. My intention in
 23 this table was, in part, to show that there is a
 24 continuing problem that have community members
 25 responding and making complaints. I anticipated that

1 other sources that might produce H2SO4, or other types
 2 of irritants, and I would look at the totality of the
 3 complaints. In other words, not just look for cough
 4 but look for cough and irritation, other things that
 5 might help identify or confirm that the Gavin facility
 6 is the responsible agent.

7 Q. Did you, in fact, do that?
 8 A. Well, it's difficult to do that, for a number of
 9 reasons. First of all, there is not much of a
 10 monitoring basis to determine whether there is an
 11 exposure of H2SO4, sulfur, nitrogen, or whatever else.

12 Second, the record is relatively limited in
 13 the monitoring, as I indicated, as well as at the
 14 emission side of things. I don't have the record of,
 15 say, day-to-day, hour-to-hour emissions or, for that
 16 matter, touchdowns or events that might produce higher
 17 concentrations. So it's a difficult task to do.

18 However, as I looked at sources in the area
 19 for irritant gases like H2SO4, and the proximity of
 20 these CAP members to the Gavin facility, it seems
 21 unlikely, in my opinion, that there is a significant
 22 alternative explanation.

23 Q. Did you look at any data on emissions prior to 2001
 24 from the Gavin facility?
 25 A. For H2SO4?

1 Q. Yes.

2 A. I don't recall looking specifically for -- I think I

3 did look briefly for the TRI database, and I just

4 don't recall what was in there.

5 Q. Did you check to see if there were any symptom

6 complaints prior to 2001 similar to those in your

7 Table 7?

8 A. I was given some information with symptom complaints,

9 but I don't recall whether they preceded 2001.

10 Q. When I say "2001," because that's when the SCRs

11 started, in the spring of that year.

12 A. That's right.

13 Q. Do you have any opinion as to the potential impacts of

14 H₂SO₄ emissions prior to 2001?

15 A. I'm sorry, potential impacts?

16 Q. Potential health impacts.

17 A. Of sulfuric acid?

18 Q. Prior to 2001.

19 A. Yeah. I mean, sulfuric acid is sulfuric acid. It

20 doesn't matter whether people haven't changed in two

21 years. You are talking about the emissions from

22 Gavin, I assume?

23 Q. Yes.

24 A. Okay. As well understood in combustion, there will be

25 some sulfuric acid produced during a combustion coal

1 odor, irritation, coughing and breathing difficulties

2 most associated with sightings and local touchdowns of

3 the Gavin plume is consistent with exposure to high

4 concentrations of H₂SO₄.

5 Do you know if those individuals reporting

6 the symptoms were actually in a visible plume

7 touchdown?

8 A. Well, my recollection is that some of them said: I

9 drove through the plume and my eyes started to hurt,

10 and so forth.

11 Based on that, I would assume some of them

12 were immersed, I guess you could say, in the plume.

13 In other cases, people would say: I saw a

14 touchdown and it moved this way, and it covered the

15 area.

16 In that case, I guess I would assume that,

17 yes, they were again within the plume, in quotes.

18 Q. Speaking about a visible blue plume, does there need

19 to be a visible plume for there to be a health risk to

20 individuals?

21 A. No. In fact, there doesn't need to be necessarily the

22 perception that they have irritation as well.

23 Q. What do you mean by that?

24 A. Irritation has been often regarded as a canary. So

25 the canary dies, you know you have a problem in the

1 without the SCRs, and this was referred to as pre-SCR

2 levels, I believe. And those concentrations are on

3 the order of single digit, typically, in the flue gas

4 effluent.

5 So there's certainly emissions of H₂SO₄

6 from Gavin beforehand. But it's also well understood

7 that introduction of SCRs provided substantial

8 increases in H₂SO₄ emissions.

9 So prior to 2001, there certainly were

10 emissions of H₂SO₄ but at levels that were a fraction

11 of what we saw in 2001.

12 Your question, I think, is it my opinion

13 that those concentrations of H₂SO₄, prior to

14 installation of SCRs, is cause to health effects? Is

15 that your question?

16 Q. Yes.

17 A. The answer, I think, I would have is that, yes, it

18 could possibly, along with the other pollutants

19 emitted from the facility, be involved in adverse

20 health effects.

21 Q. Back to page 17 of your report, I'm looking at section

22 2.4.2 entitled Individual Symptomatology is Consistent

23 With Exposure to the H₂SO₄ Plume.

24 In the italicized portion of this, you say:

25 The record of complaints from CAP members regarding

1 coal mine. But, in fact, there can be health effects

2 that occur below levels at which individuals perceive,

3 and that's well understood with this particular

4 contaminant.

5 Q. Those health effects that can occur below a perceived

6 level, are those permanent health effects?

7 A. They can be.

8 Q. What are the permanent health effects that did occur

9 below a perceived level of irritation?

10 A. Well, for example, you won't smell formaldehyde, but

11 formaldehyde below a certain level you won't smell it,

12 but below a certain level it's associated with cancer.

13 Q. What about with H₂SO₄?

14 A. H₂SO₄, based on fairly robust, in concordance with

15 literature and clinical studies, is associated, as I

16 state in section 2.5, a number of respiratory effects,

17 including lung function, particle clearance, and so

18 forth.

19 Q. Okay. You had talked about irritation being regarded

20 as a canary and that there could be permanent health

21 effects below a detectable irritation. What are those

22 permanent health effects associated with sulfuric acid

23 that would occur below a level of irritation?

24 A. Well, as I indicated, that there can be changes in

25 pulmonary function. There can be changes in

1 clearance. There are likely to be secondary impact
 2 from that, for example, greater sensitivity to cope
 3 with other pollutants exposures, or subsequent
 4 pollutant exposures.

5 Q. Are all of those permanent symptoms or transitory
 6 symptoms?

7 A. It's unclear in some ways. Lung function, for
 8 example, can often rebound. On the other hand, the
 9 effect of having an exposure in terms of other health
 10 end points is unclear. The effect of repeated
 11 exposures is also unclear.

12 Q. Let's go ahead and move to 2.5, since we seem to be
 13 talking about it anyway. Health effects of H₂SO₄.
 14 I'm looking at 2.5.1, on page 18. The first
 15 nonitalicized paragraph there says: Numerous studies
 16 have shown adverse health impacts with low to moderate
 17 concentrations of H₂SO₄ and acute duration exposure
 18 studies in both humans and animals.

19 You go through in the rest of this section
 20 and detail some of those.

21 I didn't see any animal studies in the
 22 studies that you list in your report. Is there a more
 23 comprehensive list of those studies, other than what
 24 you specifically cite in the text of your report?

25 A. Yeah. I think that, in fact, somewhere I cited that

1 would you consider it unreliable?
 2 A. I don't recall exactly where I cited it. It would
 3 help to see that.

4 Q. I had that. It's on 17, first paragraph under 2.5.
 5 You had cited it here on --

6 A. Yes, I see. That's just a fact that it's a review
 7 there that attempted to update the ATSDR. My opinion
 8 as to whether it's reliable, was that your question?

9 Q. Yes.

10 A. It provided some additional references, and I reviewed
 11 those references, and my opinion is really that it was
 12 useful for discussing the more recent literature,
 13 particularly in terms of identifying additional
 14 studies.

15 Q. Okay. You also cited as a source in your Table 1 on
 16 page 23, in there, I think it's actually in the
 17 footnote there. It says: Location inferred from
 18 Gradient 2002. Then you listed again as a source for
 19 that table.

20 A. This has nothing to do with the health effects. This
 21 has to do only with locations, I believe.

22 Q. Okay. That answers my question, then.

23 Back on page 18, midway through the first
 24 nonitalicized paragraph, the sentence starts, "This
 25 has been demonstrated in individuals" --

1 ATSDR provided a review. One of your experts working
 2 at Gradient Corp in 2002 provided a review. And he's
 3 altered some of that in his expert report of 2005 as
 4 well.

5 There is reviews in the TLV documentation
 6 for this pollutant. There are reviews in some of the
 7 other documents that I have cited. It wasn't my
 8 opinion -- rather, my task here to review all of that
 9 information.

10 Q. So you looked at these reviews of the relevant
 11 literature. You didn't necessarily look at each of
 12 those underlying studies in those reports?

13 A. No. I also reviewed a number of those reports, and
 14 you deposed -- rather, you requested my documents, and
 15 some of the studies are provided there. And in some
 16 cases, I went back to the pre-electronic age and got
 17 some of the early studies that were only available,
 18 rather fragile journal volumes hidden in the library
 19 somewhere.

20 Q. You mentioned the 2002 Gradient report. Did you
 21 consider that a reliable review of the literature?

22 A. I didn't really make an opinion whether it was
 23 reliable or not.

24 Q. But you did cite it several times in your report, so
 25 did you consider -- if you cited it in your report,

1 A. I'm sorry, I don't see where you are.

2 Q. Fourth and fifth lines into the first nonitalicized
 3 paragraph: Exercising asthmatic children have shown
 4 adverse health effects to H₂SO₄ at concentrations of
 5 70 micrograms per cubic meter.

6 A. Yes, I see that.

7 Q. How many studies did you review show clinically
 8 noticeable results at 100 micrograms per cubic meter
 9 or less?

10 A. I don't recall the numbers of studies. I mean, there
 11 are not many studies of exercising asthmatics, that is
 12 certainly the case.

13 Q. Would you say less than 10 studies show clinically
 14 noticeable results at less than 100 micrograms per
 15 cubic meters?

16 A. I'm don't think there have been even 10 studies that
 17 have looked at very low concentrations of H₂SO₄.

18 Q. So it would be less than 5?

19 A. Yes.

20 Q. And the size of the aerosol makes a difference in
 21 whether the symptoms will occur; is that correct? I'm
 22 looking at the second to last line in that same
 23 paragraph. You talk about the factors influencing the
 24 health responses.

25 A. Yes.

1 Q. What do you mean by the size of the aerosol?
 2 A. Atmospheric aerosols can be characterized by a number
 3 of properties. One of them is the size, and it's well
 4 understood that the size determines the penetration of
 5 the aerosol into the airways and down into the lung.
 6 Q. Do you have any opinion as to the size of the aerosol,
 7 the H₂SO₄ aerosol, emitted from the Gavin stacks?
 8 A. Well, it's not been characterized before. It's a
 9 difficult measurement to make. It can be made.

10 The size distribution is likely to be what
 11 aerosol scientists would characterize as
 12 polydispersed. In other words, it's a range of sizes.

13 Q. How would you go about characterizing the size of the
 14 aerosol?
 15 A. Well, I haven't thought about this. The typical ways
 16 of capturing sizes of aerosols include devices from
 17 impacters to -- to more sophisticated particle sizers,
 18 and so forth. This is an area of very active research
 19 right now in trying to characterize the health effects
 20 of PM10, PM25, ultrafines, and so forth.

21 Characterizing them for this aerosol is
 22 particularly challenging because it's quite dynamic
 23 and can change in time. The aerosol is quite fragile.
 24 It's quite reactive. And so a lot of these techniques
 25 might not work very well. So I don't have the answer

1 you will, of the plume, although I haven't
 2 seen -- this is speculation on my part because I
 3 haven't seen any scientific studies that really show
 4 the effect of water vapor with respect to the blue
 5 plume.

6 Typically, there is enough water vapor to
 7 produce H₂SO₄ from the emissions of sulfur trioxide.
 8 The effect of the additional water vapor is unclear to
 9 me.

10 Q. Would you expect any of the H₂SO₄ aerosol to be
 11 submicrometer?

12 A. In diameter?

13 Q. Yes.

14 A. A possibility, as I indicated, that it is a
 15 polydisperse size distribution.

16 Q. Do you have any opinion as to what portion of it would
 17 be submicrometer in diameter?

18 A. I haven't seen evidence that indicates that proportion
 19 in a reliable manner.

20 Q. I'm looking at the second nonitalicized paragraph in
 21 2.5.1, five lines from the bottom of that paragraph,
 22 you reference a conference -- a concentration of 120
 23 micrograms per cubic meter, and then a reference,
 24 these levels are approximately twice those that cause
 25 adverse health effects, increased respiratory

1 for you on how I would do it today. It would be a
 2 research project.
 3 Q. When you say it is quite reactive, what do you mean by
 4 that?
 5 A. Well, it's a very soluble aerosol. So the presence of
 6 a surface, for example, that might be used could
 7 affect the results that you get.

8 This is why, for example, when you are
 9 trying to determine exposures to acidic aerosols, you
 10 typically try to use things like denuders to remove
 11 caustic or basic constituents in the atmosphere that
 12 might neutralize the acid. It's just a technical
 13 challenge to do it for this particular aerosol.

14 Q. What is your understanding of why the plume is blue
 15 sometimes?

16 A. It's a combination of absorption and refraction of the
 17 aerosol with incoming light and the angle, and so
 18 forth, of the observer with respect to the incoming
 19 light, and the location of the particles.

20 Q. Is it in part due to water vapor clinging to the
 21 sulfuric acid particles?

22 A. Well, the water vapor will -- I don't know if the term
 23 is "cling" that I would use, is -- is important in
 24 understanding the aerosol and, yeah, it's probably a
 25 certain humidity range would affect the blueness, if

1 resistance in the previously cited ATSDR report.

2 Is that the 70 micrograms per cubic meter
 3 study of asthmatic children that you referenced above?
 4 I'm not sure which portion.

5 A. I think it is. I think for some reason number 66
 6 micrograms sticks in my mind as well, but 70 is close
 7 to that, so it could be the same one.

8 Q. But 120 micrograms per cubic meter isn't twice the
 9 level of most of the studies that you looked at that
 10 cause clinically significant effects?

11 A. No. As I stated, these are approximately twice.
 12 There is a plus or minus in all of these measurements.

13 Q. You said these measurements are approximately twice.
 14 I'm saying is the 120, approximately, twice the levels
 15 that you saw in other studies, other than the one with
 16 the asthmatic children?

17 A. I don't recall. There have been a couple of studies
 18 looking at levels below 100. I selected this one
 19 because it was useful in that it incorporated
 20 asthmatics as subjects.

21 Q. But most of the studies looked at concentrations
 22 greater than this 120 microgram per cubic meter; is
 23 that correct?

24 A. My -- yeah, my recollection is that most of them are
 25 looking at higher concentrations, and also not at

1 asthmatics and not at children.

2 Q. Okay. The last paragraph in this section, last
3 sentence of that, you say: Since the odor threshold
4 exceeds the level at which adverse health effects
5 occur, odor does not serve as a reliable warning to
6 individuals who might be exposed.

7 What kind of warning do you think
8 individuals need if concentrations are below 1,000
9 micrograms per cubic meter?

10 A. Well, in fact, at the end of this report, I talk about
11 types of warnings that might be used, and these are
12 provided, I think, in section 2.6.2.

13 Q. So these are the same warnings?

14 A. No. You asked -- your question was what types of
15 warnings. I'm trying to answer your question.

16 The types of warnings might be to provide
17 sirens, to provide -- what do you call it -- telephone
18 SMSs, whatever we call them, things like this, similar
19 to what we do for ozone alerts, and so forth.

20 The warning would say: As we practice now
21 via a number of mechanisms, including radio,
22 television, e-mails even, to individuals in Michigan,
23 perhaps in Ohio, elsewhere -- I'm not sure -- this is
24 not a good day to exercise outdoors, limit your
25 activities outdoors, that sort of thing. This is not

1 decades.

2 The work life has also not actually been
3 stated explicitly recently, so I don't know that it's
4 approximately 25 years or approximately more or less.

5 Q. You think that those levels of exposure are not as
6 protective of the community as the community standard?
7 Let me ask that in a better way.

8 A. I can answer that.

9 Q. Go ahead.

10 A. Reading on in the paragraph, this was noted decades
11 ago in the 1974 recommendations from NIOSH. They said
12 they were not designed for the population at large and
13 any extrapolation, and so forth, is not warranted.

14 This applies in general to other
15 contaminants that may have exposure limits or
16 guidelines. This is not a surprise to any health
17 professional. I can give you examples where limits in
18 the occupational setting are reduced by substantial
19 fractions to provide protection of the community at
20 large.

21 Q. I think you do that later on in your report.

22 A. I don't think I did.

23 Q. Talking about the California REL?

24 A. No.

25 Q. What's an example, then, where they were --

1 uncommon for ozone. And it's directed primarily at
2 asthmatics, although others are sensitive to effects
3 of pollutants.

4 Q. So the warnings you are talking about here are the
5 warnings you are talking about in section 2.6,
6 correct?

7 A. No. I didn't, in fact, in this paragraph, try to
8 extrapolate to the application of these warnings,
9 which is what 2.6 does. Here I'm simply stating that
10 in this case, odor does not operate as a canary.

11 Q. Okay. Turning to 2.5.2 of your report entitled
12 Occupational Exposure Limits For H₂SO₄ Are Approached
13 and Likely Exceeded in the Cheshire Community.

14 You note, first off, it should be noted
15 that occupational guidelines and standards are
16 designed for the occupational setting and, thus, may
17 not be protective for the general public.

18 Isn't it true, though, that occupational
19 standards are designed for exposure eight hours a day,
20 five days a week, for an approximate work life of 25
21 years?

22 A. All those are, in fact, approximate. I think if you
23 go into the history, you will see six hours or eight
24 hours or ten hours, depending on the time, because
25 these things have been around since, I don't know, for

1 A. For example, the current occupational limit for sulfur
2 dioxide, which is perhaps the best study and well
3 characterized, gas in the occupational setting is 5
4 ppm for the 8-hour exposure that you were just
5 discussing. Whether it applies for 40 hours in 25
6 years, is fine. I will take that.

7 So the limit is 5. I believe that NIOSH
8 has a TLB of 2, a little more protective than what
9 OSHA enforces. But the SO₂ National Ambient Air
10 Quality Standard, which is designed to provide
11 protection to the public, is set, I believe, at 0.03,
12 which is on the order of 100 times or several hundred
13 times lower than the occupational standard is.

14 Q. Is that because individuals in the community are there
15 24 hours a day?

16 A. In part, but that doesn't explain the magnitude of the
17 difference entirely. In fact, it hardly explains.

18 Q. What explains the difference?

19 A. A number of factors: Occupational standards are
20 designed for typically healthy workers. They are
21 designed for workers who are dealing with a relatively
22 limited number of simultaneous co-exposures.

23 They are designed to protect -- I'm sorry,
24 the ambient standards would be designed to protect
25 vulnerable, susceptible individuals; for example,

1 pregnant women, asthmatics, HIV or immunocompromised
 2 individuals, so forth. So there are additional
 3 reasons that have been quite well developed and
 4 explained in the literature that can help explain the
 5 more protective -- or, rather, the lower levels that
 6 are used for protection of the general public as
 7 compared to workers in occupational settings.

8 Q. I'm looking at the first paragraph on page 19. You
 9 talk about the ACGIH exposure limits. That's the
 10 American Conference of Governmental Industrial
 11 Hygienists.

12 You reference in 1989 that a short-term
 13 exposure limit or ceiling of 3,000 micrograms per
 14 cubic meter for a 15-minute period.

15 Is that short-term exposure limit still
 16 there in the ACGIH materials?

17 A. I don't recall for sure. I'm just citing what they
 18 did in 1948.

19 Q. Do you know if there is a short-term exposure limit?

20 A. For H₂SO₄?

21 Q. Yes.

22 A. My mind is blanking this morning on me. I should have
 23 stated it in here, and reading down -- and this
 24 paragraph, ACGIH revised it, as you can read.

25 Q. Uh-huh.

1 possibility that a 15-minute average, had it been
 2 available, could have been above 3,000, even though
 3 the 1-hour average was not.

4 Q. You reference in the third paragraph on this page,
 5 that the ACGIH levels and values are -- the last
 6 sentence of this paragraph -- often adopted by
 7 authorities as standard including cognizant
 8 authorities in the United States.

9 Do you know what authorities have adopted
 10 the ACGIH, TLVs and STELs?

11 A. Well, I mean, typically OSHA, state agencies, and so
 12 forth, will adopt them.

13 Q. Do you know of any --

14 A. Internationally, they are looked at quite closely as
 15 well.

16 Q. Do you know of any authority who has adopted them as
 17 safe levels for community exposure?

18 A. No. Typically, what a community level -- community
 19 guideline or standard will do is take something like a
 20 TLV, in the absence of any other standard, and then
 21 apply a safety factor to it, typically a factor of 10.
 22 And then use that as a health-based guideline, or I
 23 wouldn't call it standard typically. So they are used
 24 in that context, but they would not be simply taken
 25 out and used one for one.

1 A. The previous limits were assigned as STELs, short-term
 2 exposure limit, is now 3,000.
 3 Q. Right. Then there is another revision in 2004, which
 4 you reference in the next paragraph. But you don't
 5 reference the short-term exposure limit in that. I
 6 just wondered if that meant that the short-term
 7 exposure limit is still 3,000 micrograms per cubic
 8 meter?

9 A. I just don't recall whether they revised. I recall
 10 the document in detail, but I just don't recall that
 11 specific.

12 Q. Did you see any data that would indicate to you that
 13 there was an exceedence of a short-term exposure limit
 14 of 3,000 micrograms per cubic meter in 2001 or 2002?

15 A. Would you clarify, any evidence or any data, is that
 16 what --

17 Q. Yes.

18 A. No. The only data that exists that would be
 19 applicable for your question is the monitoring data,
 20 and the maximum short-term concentration that was
 21 monitored in the vicinity of the plant was, I believe,
 22 2,410, and that's below 3,000.

23 But, of course, the STEL is a 15-minute
 24 period, and the 2,410 is over a one-hour period. So
 25 as I talk about later in the report, there is

1 Q. Why is that factor of 10 generally used; do you know?
 2 A. I didn't say it was generally used. There are
 3 complications of factors that range from 1 to 2.5 to
 4 10 to 100, and so forth. 10 is just an example of a
 5 safety factor.

6 Typically, safety factors are used for a
 7 variety of reasons, and it would depend on typically a
 8 review of the individual situation that would include
 9 the uncertainty associated with the health end point,
 10 the significance of the health end point of whether
 11 there was animal data that was the basis or human data
 12 that was the basis of the TLV or other standard.

13 Many other factors would make the
 14 determination what the appropriate safety factors
 15 should be.

16 Q. Now, give you an example here where you could have a
 17 very high peak concentration that, over a seven- or
 18 eight-hour averaging period, actually yielded a low
 19 concentration.

20 But is the opposite also true, if you had a
 21 1-hour averaging time and your concentration for that
 22 one-hour averaging time was 300 micrograms per cubic
 23 meter, would that mean that the 15-minute averaging
 24 time could be lower than that 300 micrograms per cubic
 25 meter?

1 A. The maximum could not be lower, no. That's not a
2 correct interpretation.

3 You have to think, if you will, of an hour
4 being, say, broken into 4 quarters, each 15 minutes
5 long. If your average over the 1-hour period is, for
6 example, 300, which was the hypothetical you just
7 placed to me --

8 Q. Uh-huh.

9 A. -- then at least 1 of those quarters would have to be
10 above 300.

11 Q. That makes sense. 2.5.3, which is called reference
12 levels -- reference exposure levels for H₂SO₄ are
13 exceeded in the Cheshire community.

14 You are talking about these RELs, what
15 exactly are these RELs?

16 A. Well, on the bottom of page 19, I define it,
17 continuing on to 20, RELs defined as the concentration
18 level at/or below which adverse health effects are
19 anticipated for specified exposure duration.

20 Q. Those are community standards, then?

21 A. They are intended normally to be community standards,
22 yes.

23 Q. In the next paragraph, you say: The most
24 comprehensive assessment of RELs has been performed by
25 the State of California.

1 susceptibility, what you may -- whatever you may want
2 to call that, is known to vary tremendously.

3 For example, asthmatics, we find often have
4 responses to air pollutants to air levels that are far
5 lower than what a healthy individual would have and,
6 thus, community standards were typically designed to
7 try to be protective of more susceptible members in
8 the community.

9 This is well accepted and the basis, for
10 example, of ambient air quality standards.

11 Q. Okay. Moving to 2.5.4, which is entitled Emergency
12 Guidelines For H₂SO₄ Are Exceeded in the Cheshire
13 Community.

14 You reference these AEGLs, and you
15 reference an AEGL-1. There are actually AEGL-2s and
16 3s, correct?

17 A. That's correct.

18 Q. Why don't you reference these in your report?

19 A. Well, a couple of reasons. First of all, AEGLs are,
20 as I mentioned, exposure guidelines applicable to
21 rare, maybe one-time-in-your-life events, like a fire
22 explosion. They are not designed to provide a
23 guideline value for a situation which might occur
24 repeatedly over time.

25 And when I see an emergency situation, and

1 Why do you say that that's the most
2 comprehensive assessment?

3 A. Well, I haven't seen too many others assembled, for
4 one thing, and California normally does a pretty
5 consistent job, and their environmental staff are
6 often leaders and, generally, what comes out is
7 useful.

8 Q. Do you know if Ohio has any assessments of RELs, or
9 has done any assessments?

10 A. I believe I searched and I didn't find anything;
11 otherwise, I think I would have reported it.

12 Q. Does the exceedence of an REL inevitably mean an
13 adverse health effect?

14 A. No. Exceedence of a concentration if no one is there,
15 doesn't mean anyone is harmed, as we discussed
16 yesterday.

17 Q. What if there is a healthy individual there. So that
18 exceedence of that REL necessarily mean an adverse
19 health effect if there is exposure?

20 A. For an individual case, I can't determine whether or
21 not there would be an adverse health effect.

22 RELs are typically devised in a manner
23 which it is believed, as was stated, that exceedence
24 could cause an adverse health effect.

25 Individuals' sensitivity, vulnerability,

1 I mentioned, for example, a sulfur fire yesterday to
2 you, it's very useful for professionals to have
3 indications of what are emergency guideline levels so
4 they can issue warnings like evacuate the area.

5 So these levels that are developed by NRC,
6 EPA, and others, are essentially devised to provide
7 that benchmark value for decisions of whether to
8 evacuate, shelter in place, or do something else.

9 Q. Would you expect exceedence of AEGL-1 to prompt
10 evacuation?

11 A. No. Typically, AEGL-1 would be -- let me retract
12 that.

13 Evacuation is sought with all types of
14 difficulties, and most of the emergency response
15 professionals will know that you can cause a lot of
16 damage by calling for an evacuation.

17 This kind of damage can include panic, it
18 can cause people to be outdoors more, in buses and
19 cars, or whatever, or largely unprotected against a
20 toxic gas release. So it is with great reluctance
21 that any firefighter, captain, whatever, would call
22 for an evacuation. This is well understood.

23 So AEGL-1 would -- if it was felt it would
24 not escalate into a more hazardous situation, would
25 normally not call for an evacuation, rather than

1 something like shelter in place might be more
 2 appropriate. But it's really hard because it depends
 3 on the particulars in the particular scenario. You
 4 haven't specified the scenario. You have just said
 5 "in general."

6 Q. Are you aware of any circumstances where there was an
 7 evacuation after an exceedence of this AEGL level of
 8 H₂SO₄?

9 A. At Cheshire?

10 Q. Ever.

11 A. I haven't looked for that. As I indicated before, I
 12 would be surprised if it was called for.

13 Q. Let's look at 2.5.5, and then we can take a break
 14 before we go to 2.2.6.

15 A. You are making me go extra long this morning.

16 Q. We can take a break if you would like.

17 A. I'm fine.

18 Q. How would you define an adverse health impact?

19 MR. BAILEY: Are you asking him how he
 20 defines it?

21 MS. CRABTREE: Yes.

22 MR. BAILEY: Some of these questions...

23 A. I think in this case, what I have written here is that
 24 adverse health effect would include these cases
 25 including acute irritation, a change in pulmonary

1 above those that have been shown in well controlled,
 2 say, clinical settings to cause several health
 3 effects, adverse health effects.

4 We have visual evidence with this blue
 5 plume. We have modeling evidence that indicates
 6 levels can exceed 100 or, not more, micrograms.
 7 Again, the totality of the evidence is that, in my
 8 opinion, there is a -- is consistent.

9 Q. You list some specific adverse health effects. I just
 10 want to cover a couple of these to make sure I'm clear
 11 on them. You have acute irritation, changes in
 12 pulmonary function.

13 What is a change in pulmonary function that
 14 would be a result of sulfuric acid exposure?

15 A. Well, for example, on a pulmonary function test where
 16 we are looking at the resistance and the flow of
 17 breathing, we will see substantial changes in those
 18 parameters.

19 Q. But, again, you haven't actually seen any of these
 20 tests run?

21 A. I haven't looked at the medical records, so I don't
 22 know if individuals in Cheshire actually had pulmonary
 23 function tests performed.

24 Q. What about altered -- I'm not going to get that
 25 right -- mucociliary clearance?

1 function, clearance of breathing, exacerbation of
 2 asthma. I would include all of these as adverse
 3 health effects.

4 BY MS. CRABTREE:

5 Q. If the health effect went away after a period of time,
 6 say an hour, or was a transitory effect, would you
 7 still consider it an adverse health effect?

8 A. I do consider that an adverse health effect.

9 Q. You say in 2.5.5 that the sulfuric acid releases have
 10 resulted in adverse health effects.

11 What specific evidence do you rely on for
 12 the fact that the sulfuric acid has resulted in those
 13 adverse health effects?

14 A. Well, first we have the symptomology of the
 15 individuals that's documented. I think that was in my
 16 report, a summary in Table 6; is that correct?

17 Q. I think it was 7.

18 A. You are correct, Table 7.

19 Q. Show that symptomology?

20 A. That's called symptomology --

21 Q. Uh-huh.

22 A. -- of what the people are experiencing as reported by
 23 their symptoms.

24 Second, we have limited, but useful in
 25 cases, monitoring data that indicates levels can go

1 A. Exactly.

2 Q. How do you define that?

3 A. This has to do with the removal of materials from the
 4 lung.

5 Q. How would you measure that?

6 A. This can be measured in some clinical tests.

7 Q. Again, you haven't seen any medical records or
 8 clinical tests from the CAP members or other Cheshire
 9 individuals?

10 A. No, I haven't.

11 Q. You mentioned exacerbation of asthma. What do you
 12 consider exacerbation of asthma?

13 A. Well, there are a number of ways to characterize
 14 exacerbation of asthma. You can look at
 15 symptomatology. You can use pulmonary function tests.

16 You can use the frequency and severity of indicators
 17 like wheeze. You can look at asthma medications, the
 18 frequency and the cost of medications. You can look
 19 at emergency room visits. You can count asthma
 20 attacks; you can look at days home from school or work
 21 for children or adults respectively. There are many
 22 ways to look at exacerbation of asthma.

23 Q. But, again, not to be redundant, you haven't seen any
 24 medical records or clinical evidence of this?

25 A. In the Cheshire community, I have not.

1 Q. Okay. The last part of 2.5.5, you say that the Gavin
 2 facility will continue to represent an imminent and
 3 substantial endangerment to public health.

4 Is "imminent and substantial endangerment
 5 to public health" a toxicological term of art?

6 A. Can you clarify a toxicological term of art.

7 Q. Is a term of art to you, in your profession?

8 A. I'm not familiar with the word "term of art," the
 9 phrase of "term of art."

10 Q. Is it a common phrase in your profession?

11 A. The words "imminent," "substantial," are common.

12 Q. I'm talking about the phrase "imminent and substantial
 13 endangerment to public health."

14 A. To me, it's essentially recognizing -- well, your
 15 question was, is it common? I don't know. I have
 16 never researched whether this is common or not.

17 Q. I asked because it reflects some legal language in the
 18 statutes at issue. I wasn't sure if it was also a
 19 common phraseology in what you do.

20 If it's not, then I guess my next question
 21 to you is, what does this mean to you, imminent and
 22 substantial endangerment to public health?

23 A. To me, it means that there is a concern of substance
 24 that represents a public health threat; that actions
 25 should be taken to provide what I would consider

1 A. Sure. Do you need additional clarification beyond
 2 what's in the footnote?

3 Q. Let me ask you this: If you took the maximum
 4 ground-level concentration from the ISC modeling that
 5 you did, which was 130 micrograms per cubic meter,
 6 using your rollback method, what would the emission
 7 limit in grams per second or parts per million to keep
 8 emissions under 120 micrograms per cubic meter?

9 A. I would be very reluctant to approach it in that
 10 manner. The rollback can be based on modeling that
 11 way, but in the case where a model is performing
 12 poorly, you would be ill advised to do it that way.

13 Q. If you did do it that way, what would the new emission
 14 limit be?

15 A. That, I can't answer with much clarity either because
 16 I don't know, in fact, what the emissions of H₂SO₄
 17 precursors were that corresponded to the 2,410
 18 micrograms per cubic meter exceedence or measurement.

19 Q. But putting aside the 2,410 --

20 A. But I can't put that aside -- I'm sorry, let me hear
 21 you out.

22 Q. Okay. If the maximum concentration had been 130
 23 micrograms per cubic meter, what would the new
 24 emission limit need to be to keep emissions under the
 25 referenced exposure level of 120 micrograms per cubic

1 reasonably protective mitigation, or actions that are
 2 reasonably protected to mitigate the potential for
 3 health adverse -- you are getting me tongue-twisted --
 4 for adverse health effects.

5 MS. CRABTREE: Why don't we go ahead and
 6 take a break.

7 (A recess was taken)

8 BY MS. CRABTREE:

9 Q. Turning to 2.6 of your report, on page 21, where it
 10 starts -- entitled Recommendations to Minimize H₂SO₄
 11 Exposures and Risks. You recommend an emission limit
 12 of less than one part per million; is that correct?
 13 This is the first bullet point under 2.6.1.

14 A. No. As it stated, I recommended essentially a lower
 15 numerical and verifiable limit on emissions. And I
 16 didn't calculate the value exactly. Clearly there are
 17 a number of ways to calculate that, but if we wanted
 18 to keep ambient concentrations below an REL of
 19 approximately 120, I think this number would provide
 20 that.

21 Q. And that number being the 10 grams per second?

22 A. As an example of a number that would provide that.

23 Q. You footnote at the end of that bullet point, and can
 24 you walk me through this rollback method that you used
 25 to come to that limit?

1 meter?

2 A. That's what I thought you were going to say. I
 3 still -- I can't tell you precisely without making
 4 some assumption with respect to what the emission
 5 limits -- rather, what the emissions were during the
 6 time of the -- I'm sorry, the 100 -- I'm twisted now.

7 I would -- in the case of the modeling,
 8 where we assume in my modeling something on the order
 9 of 17 or 18 ppm, producing 130, we would need to
 10 reduce that by something on the order of 10 percent.
 11 Rather than being 17 or 18, it would be 15 or 16.

12 Q. Okay.

13 A. But, as I indicate, I would be reluctant to suggest
 14 that. So suggesting, that's an inappropriate
 15 methodology.

16 Q. On the fourth bullet point in this section, you say
 17 the numerical emission limit is better expressed as a
 18 maximum hourly emission rate rather than as a stack
 19 gas concentration.

20 Why is it better expressed as a maximum
 21 hourly emission rate?

22 A. For a couple of reasons, although it can be argued
 23 that you can derive it either way. But, typically,
 24 stack emission rates are provided in terms of a
 25 maximum rate in grams per second, grams per hour, tons

1 per year, and so forth.

2 This has the advantage of incorporating
3 both what I would call the volumetric flow, in other
4 words, in this Gavin facility, which is a base-load
5 facility, but we have seen some degrees of ups and
6 downs in terms of its power production. That emission
7 limit expressed in terms of an hourly emission rate
8 automatically accounts for those ups and downs. So
9 it's preferred and commonly used that way in permit
10 applications.

11 Q. Underneath that bullet point, you say that better
12 control technology is available and feasible that can
13 provide enhanced removals of SO₃/H₂SO₄ emissions and
14 is currently installed at Gavin.

15 What are those control technologies?

16 A. Well, I didn't provide an extensive review of control
17 technologies. I have examined a bit of the evidence
18 with respect to the record at Gavin and, for example,
19 I know that they tried additional approaches,
20 including lower sulfur of coal. They are moving to
21 lower catalysts. There was water injection, magnesium
22 hydroxide injection, lime injection, trona injection.

23 Typically, the way I look at these things
24 is as an optimization to try to provide combination of
25 techniques that is effective. That's what they have

1 that are higher or lower from that.

2 Again, in terms of considering the overall
3 system design, I would be concerned about performance
4 of the pollution controls. I would be concerned about
5 the impact on plant efficiency. I would be concerned
6 about a number of different factors. I would approach
7 it as a systems problem.

8 Q. Other than wet ESPs, what other control technology do
9 you feel the plant has not tried?

10 A. Those are the things that come to mind right now.

11 Q. You say that these control technologies are feasible.
12 Have you done any feasibility study?

13 A. No, I haven't done a feasibility study.

14 Q. Have you evaluated any cost to install or maintain any
15 of these suggestions that you make?

16 A. I have seen some numbers in the record that examine
17 cost of some of these things and -- but I haven't seen
18 what I would consider to be a systematic assessment of
19 the -- of the technical options.

20 Q. Did you make any assessment of whether any of these
21 options would have any ancillary emission impacts?
22 And I will give you an example: When the SCR went
23 into service to reduce nitrogen dioxides, there was an
24 increase in the SO₃/H₂SO₄ that we are talking about
25 today. Would any of these options that -- have you

1 tried.

2 What they haven't tried are other types of
3 systems to provide more effective SO₃/H₂SO₄ control.
4 For example, wet scrubbers are also known to provide
5 higher removals.

6 Q. Wet scrubbers?

7 A. Wet precipitators, I'm sorry.

8 Q. Wouldn't a wet -- an ESP is an electrostatic
9 precipitator, is that what you are talking about?

10 A. Yes.

11 Q. I have heard them referred to as wet ESPs.

12 A. Wet ESPs, yes. They already have a sulfur scrubber at
13 Gavin.

14 Q. Wouldn't a wet ESP actually reduce the exit
15 temperature of the plume?

16 A. As I indicated, they approach these things as a
17 system. The temperatures that are passed through the
18 ESP are a function of many operating parameters. So
19 you might make adjustments elsewhere in the system to
20 maintain temperatures at some potential, what you feel
21 is acceptable.

22 Currently the temperatures at Gavin stack
23 are very low. In the modeling, I think we used
24 temperatures of 120 or 130. It would be not difficult
25 to adjust the process conditions to get temperatures

1 looked at any of the options that you suggest to see
2 if there would be similar ancillary impacts on
3 emissions?

4 A. Well, there are interactions between these things, and
5 again, I'm coming back to the systems perspective
6 because typically you look at a facility as a whole.

7 And I understand that injections of
8 different materials can affect, for example, particle
9 resistivity, which influences efficiency of your
10 particular removal device if you are using an ESP.
11 But I haven't done a systematic assessment.

12 In particular, that's one of the reasons
13 this case is interesting, because it provides a -- it
14 demonstrates the complexities that occur when you
15 don't necessarily have a systematic view of emissions
16 and, you know, the kinds of outcomes that can result.

17 Q. You mentioned earlier that it would not be difficult
18 to get higher exit temperatures. What would you do to
19 get those higher exit temperatures?

20 A. At Gavin?

21 Q. Yes.

22 A. Well, I haven't done an engineering analysis at Gavin.
23 I mean, I have various parameters that they can
24 control to affect temperatures. They have various
25 feed rates that they can control to affect

1 temperatures, and so forth.

2 My experience is that other utilities have
3 in the past altered temperatures for various reasons.
4 And Gavin doesn't seem to be any different from that
5 and, certainly, they understand that, how to do this.

6 Q. You have said that temperatures have been adjusted in
7 the past, that you have seen. On what -- by how much?

8 A. I can't recall offhand numerical value at specific
9 locations in the facility. I mean, temperatures at
10 this facility range from, you know, very, very hot at
11 the boiler to just a little bit above ambient
12 temperature at the stack. So, I mean, it depends
13 where you are talking, and so forth.

14 For example, a facility like this will
15 adjust conditions to reduce slagging issues, and so
16 forth, on a fairly routine basis. If they are finding
17 that temperatures drop at a location where it's
18 important to maintain a temperature for some process
19 condition, they will adjust that. So these things are
20 done quite routinely.

21 I don't know what capabilities they have
22 numerically, but they certainly have the ability to do
23 that. That's critical for the operation of this kind
24 of facility.

25 Q. In this, you mentioned the use of higher quality coal.

1 Q. Is it your opinion that it's possible for a coal-fired
2 facility with a scrubber and SCR to achieve emissions
3 of 1 part per million of SO₃?

4 A. I don't know. I have seen -- I would say -- I would
5 characterize no consistent information on -- I
6 wouldn't say consistent, but representative emission
7 information on SO₃.

8 My expectation is that given the fact that
9 SO₃ removals haven't been routine, that knowing on the
10 order of a percent or so of sulfur in a typical boiler
11 will be converted to SO₃, and knowing that certain
12 removals, depending on the specifics of the plant,
13 what kind of pollution-control system, that there will
14 be a certain fraction of SO₃ emitted.

15 My guess is probably that this limitation
16 of 10 grams per second -- is that the one you are
17 referring to?

18 Q. Uh-huh.

19 A. Would be difficult to achieve at a large facility like
20 Gavin.

21 Q. Turning to page 22, we talked about you -- you talk
22 about monitoring plan here. And we talked about that
23 a little bit yesterday, as to how you would have
24 changed the ambient monitoring plan. But in 2.6.2,
25 it's entitled Additional Measures to Mitigate

1 What do you mean by higher quality coal?

2 A. This is largely referring to the sulfur content of the
3 coal.

4 Q. Okay. As a sulfur content goes down -- let me
5 rephrase that.

6 Are you aware of any equipment difficulties
7 with using low-sulfur coal at plants that were
8 designed to burn high-sulfur coal?

9 A. Yeah. In particular, in this case, I believe the
10 deposition of Osborn has a discussion that the
11 lower-sulfur coal -- I'm not sure if that was Wyoming
12 coal -- but produced, I think it was slagging
13 problems, but I'm not sure how much this was actually
14 investigated.

15 Typically in a facility like this, you want
16 it to last for many, many years. You make
17 short-term tests. You make some short-term
18 corrections, but it does take some time to sort of get
19 the process down and it operates in the kind
20 reliability we like to see for base-loading
21 facilities, which is very high standards to
22 obtain -- to maintain, rather.

23 But it's not clear to me that that couldn't
24 be achieved with a use of a different coal, from the
25 high-sulfur coal.

1 Exposures and Risks.

2 Before the bullet points, one of the things
3 you identify is exhaust gas reheat and increase stack
4 velocity -- stack gas velocity.

5 What is involved in achieving increased
6 stack gas velocity?

7 A. I'm sorry, which bullet points?

8 Q. Right under the italicized portion.

9 A. Got it. Your question was?

10 Q. What exactly is involved in achieving increased stack
11 gas velocity?

12 A. I don't know the details at Gavin but, typically, you
13 have fans that might have to be run at a higher power
14 to produce a greater velocity.

15 Q. Anything else?

16 A. At Gavin, I don't know the specifics that would be
17 involved.

18 Q. Okay.

19 A. There could be redesign of the stack, or the
20 termination of the stack but -- and that might have
21 some other engineering consequences. Again, I don't
22 know the specifics at Gavin.

23 Q. Moving to your bullet points on this page, the first
24 bullet point says: Continuous observation and
25 monitoring of conditions in the area. What do you

1 mean by that?

2 A. Well, there are a couple of things. As I stated here
3 at the onset, I didn't provide a comprehensive
4 assessment of all the additional mitigating measures
5 that might be used. That's a -- that requires more
6 analysis, which I simply didn't have time to provide.

7 As other pollutants, typically we try to
8 measure them continuously so that we understand the
9 kinds of concentrations that are likely to occur.

10 In a case of a power plant, the typical
11 type of monitoring that work that might be used could
12 include sighting of continuous monitors at what we
13 call hot spots of locations where plume touchdowns, if
14 you will, are likely to occur. It might include
15 locations that are where populations are most likely.
16 Those would be considered population-oriented sites.

17 It might include background sites to get at
18 the question as to whether there are other sources
19 that might provide, in this case, H₂SO₄ exposure. So
20 this is just an example of the way that you would try
21 to develop a spacial and temporal understanding of the
22 pollutant levels for the purpose of, well, you know,
23 protecting public health and understanding things like
24 frequency of plume touchdowns.

25 Q. Okay. You go through and identify several suggestions

1 that these measures will be especially important if
2 emission limits do not approach that level. And I
3 would infer, and I would ask you to infer from that,
4 then with low levels of emissions, these measures
5 would not be necessary.

6 Q. When you said 10, you meant 10 grams per second?

7 A. 10 grams per second.

8 Q. Not 10 parts per million?

9 A. That's correct. That's stated in the written record,
10 but I need to say it.

11 Q. I just want us to be clear.

12 You don't necessarily have an opinion as
13 far as which of these measures should be used, but
14 they are more of suggestions of things that could be
15 used?

16 A. Well, I stated yesterday that the primary intent of
17 this report was not to design these measures; instead,
18 it was to do a couple of other things. But I do have
19 some opinions about what I think would be appropriate
20 and useful.

21 Q. What are those, or what is that?

22 A. Well, there are a number of them. And they are
23 certainly going to include better monitoring, and
24 potentially some of the other points as well.

25 Q. Which other points?

1 here. Are you saying that the types of suggestions
2 that you are looking at here, and some of them are
3 pager alerts, you mentioned before the SMS text on
4 phone, sirens, websites.

5 Are you saying that these should be put in
6 place to warn residents anytime that emissions from
7 the Gavin facility exceed 10 grams per second?

8 A. There is really two parts to my answer. First is, I'm
9 not saying that specifically these are the appropriate
10 measures that should be used. I said, in the first
11 case, these are measures that might be used. And it
12 would be based on what local individuals feel is
13 appropriate, what is feasible to do, and many other
14 considerations.

15 For example, I don't know definitively that
16 people have e-mail; or if they don't have e-mail,
17 e-mail is not appropriate.

18 The second part is, the emission limit is
19 designed to be protective in ensuring with a high
20 degree of likelihood that there will not be high
21 concentrations in the area. And if you had emissions
22 as low as, for example, 10, then most likely you would
23 not have plume touchdowns that would result in high
24 levels of H₂SO₄ and adverse health effects.

25 As I state, I think in the italicized part,

1 A. Well, I haven't thought about the others in much
2 detail yet for the purpose of your question.

3 I think it's actually quite appropriate to
4 provide some sort of warning system to residents, and
5 which is appropriate, I can't say offhand because I
6 don't know the community that well. But certainly, as
7 I have noted here on page 22, including the footnote,
8 these types of strategies are becoming commonly
9 employed in areas that have problems meeting
10 air-quality levels that are protective.

11 And as an example, in Michigan, we have
12 e-mails that are sent out. We have websites where you
13 can see alerts. We have a variety of mechanisms aimed
14 at alerting especially susceptible individuals not to
15 go outside, limit their outdoor activity. It's on the
16 radio and elsewhere. These are inexpensive and they
17 can be effective.

18 In a case of the Cheshire situation where
19 you have a fairly major road going through the area,
20 the possibility of acute effects for individuals
21 driving through, it's a little more problematic.

22 Cars, even with windows closed, don't
23 provide tremendous attenuation of pollutants; in other
24 words, pollutant concentration outside the vehicle is
25 typically not all that much different from the

1 concentration in the cabin of the vehicle. And this
 2 applies in cars even if you have the windows closed,
 3 and so forth. It helps a little bit but not a lot.
 4 That's a bit more problematic to deal with.

5 And I don't know how to address that sort
 6 of situation, or other inadvertent exposure, except by
 7 limitations that essentially remove the source of the
 8 problem.

9 Also, I would have to say that the
 10 philosophy of air quality and public protection is to
 11 put the burden on the polluter and that responses like
 12 requesting the individuals to wear personal protective
 13 equipment is generally not the desirable strategy.

14 Q. What personal protective equipment would that be for
 15 sulfuric acid?

16 A. For example, you might wear a mask which neutralizes
 17 the acid. It's not very appropriate, in my opinion,
 18 to ask people to wear those masks while they are
 19 exercising.

20 Q. What ambient level would you consider high enough to
 21 prompt an evacuation of Cheshire?

22 A. An evacuation of Cheshire?

23 Q. Yes.

24 A. For H₂SO₄?

25 Q. Yes.

1 Q. You mentioned yesterday, when you were at the plant
 2 for a site visit that you saw a tinge of blue plume.
 3 Did you experience any health effects when you were
 4 there?

5 A. Yes.

6 Q. What health effects did you experience?

7 A. In climbing up the boiler, it was very hot, but I was
 8 far out of the plume and I was sweating profusely, but
 9 I had no effects due to the H₂SO₄.

10 Q. Are there any opinions that you plan to offer that are
 11 not contained in your report or that we have talked
 12 about in the past two days?

13 A. That I will offer when and where?

14 Q. If the case were to go to trial, in your testimony.

15 A. Possibly, sure.

16 Q. What other opinions are those?

17 A. Well, first of all, it would depend on what I was
 18 asked, I think.

19 Q. Are there any specific additional opinions other than
 20 what is in your report and that we have talked about,
 21 that you plan to offer at trial in this case?

22 A. The only one that comes to mind right now is the
 23 Valburg's report on mine -- discusses the
 24 epidemiological evidence, and I didn't provide any
 25 depth on that in this report. And so that's one area

1 A. I would go back to some of the emergency response
 2 guideline limit values, and I think, as you indicated,
 3 I didn't provide what the second levels were in this
 4 report, and offhand I don't recall what they are
 5 either. It's likely to be on the order of 1,000 or
 6 several thousand.

7 Q. So that second level would be a good guideline for
 8 evacuation?

9 A. That would be a guideline. There are a number of
 10 guidelines that are available.

11 There are a couple of other limits that are
 12 cited in my report and, in fact, you know, the NRC has
 13 levels here of 1,000, 2,000, 5,000. This depends on
 14 the duration of exposure, as I mentioned to you, and,
 15 you know, we understand that the -- if it is a
 16 duration that is likely to be long, then things like
 17 sheltering in place may not be very effective. And so
 18 if the duration is long, we might consider a lower
 19 number to be appropriate. If the duration is short,
 20 we might expect a higher number to be appropriate.
 21 And, in part, that's the reason for the multitude of
 22 guideline limits and emergency limits that we have.

23 You know, most of the numbers are in the
 24 thousands of range; and how many thousands, 1,000 or
 25 5,000, it depends on a number of factors.

1 which could come up which I might have an opinion on.

2 Q. Were you asked to prepare a rebuttal report?

3 A. No, I don't think I have.

4 Q. Did you know that you had an opportunity to prepare a
 5 rebuttal report?

6 A. I think Jim Hecker and I discussed the possibility.

7 MS. CRABTREE: If we can just have two
 8 minutes, I think I'm done.

9 (Discussion off the record)

10 MS. CRABTREE: I thank you for your time,
 11 Dr. Batterman. That's all the questions I have for
 12 you.

13 THE WITNESS: Thank you.

14 MR. BAILEY: We are done. We will read it.

15 (Deposition concluded at 11:05 a.m.)

16 Signature of the witness was requested)

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1 CERTIFICATE OF NOTARY

2 STATE OF MICHIGAN)

3) SS

4 COUNTY OF OAKLAND)

5

6 I, Karen Klerekoper, a Notary Public in
7 and for the above county and state, do hereby certify
8 that the above deposition was taken before me at the
9 time and place hereinbefore set forth; that the
10 witness was by me first duly sworn to testify to the
11 truth, and nothing but the truth; that the foregoing
12 questions asked and answers made by the witness were
13 duly recorded by me stenographically and reduced to
14 computer transcription; that this is a true, full and
15 correct transcript of my stenographic notes so taken;
16 and that I am not related to, nor of counsel to either
17 party nor interested in the event of this cause.

18

19

20 

21 Karen Klerekoper, CSR-4250, RPR

22 Notary Public,

23 Oakland County, Michigan

24

25 My Commission expires: 10/7/06

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Date: 6/19/06

TO : Molly S. Crabtree
Porter, Wright, Morris, and Arthur

Re: CASE: Cap v. Ohio Power Company

DEPONENTS: Stuart Batterman, Ph.D

DATE: 1/5/06, 1/6/06

Enclosed please find the original transcripts of the above deposition(s) and attendant exhibits, if any.

The errata sheet and signature page are enclosed.

There has been no response from the witness. We are forwarding the original to you, assuming that signature has been waived.

Sincerely,

Patricia Murray & Associates